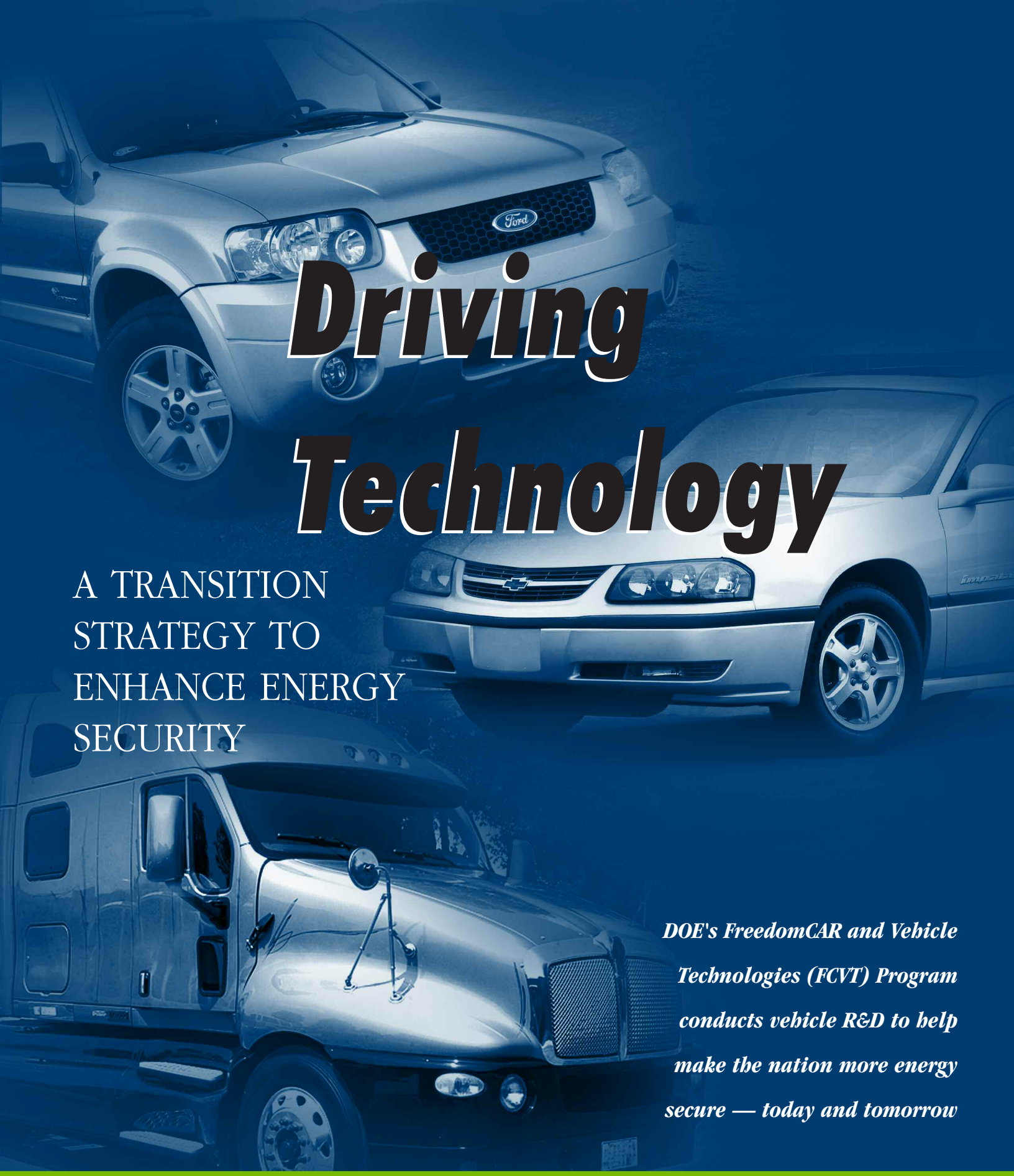


Driving Technology

A TRANSITION STRATEGY TO ENHANCE ENERGY SECURITY

DOE's FreedomCAR and Vehicle Technologies (FCVT) Program conducts vehicle R&D to help make the nation more energy secure — today and tomorrow

U.S. Department of Energy
Energy Efficiency and Renewable Energy
Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

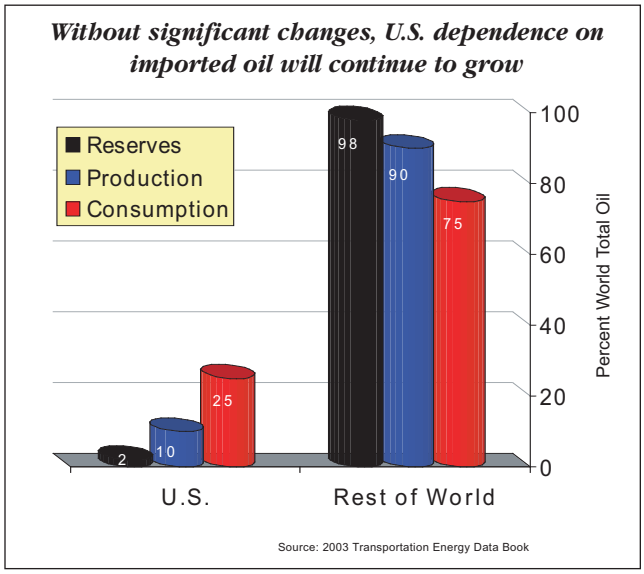
21ST CENTURY TRUCK PARTNERSHIP

FreedomCAR & Fuel Partnership

Reducing transportation petroleum use while helping make fuel cell vehicles practical

The problem: oil dependency threatens our energy and economic security

Worldwide, oil production is not keeping pace with demand, which is growing rapidly as China (now the world's number two oil consumer) and other developing nations increase their appetites for oil as their economies expand. Oil price increases feed inflation and decrease the gross domestic product (GDP), resulting in lost jobs — initially in the transportation, chemical, utility, and manufacturing sectors, then rippling throughout the economy. We can only produce about 40 percent of the oil we currently need; we must import the rest. Imported oil is costing us about $200 billion per year, having doubled in only two years. Unless we begin the process of reducing our dependence on foreign oil, we risk that our energy and economic security (i.e., jobs and standard of living) will be compromised.



The Energy Information Administration (EIA) projects that U.S. imports of oil will grow from 10 million barrels per day (mbpd) in 2003 to almost 20 mbpd by 2025.

The most urgent need is to address the transportation sector, which consumes two-thirds of all U.S. oil (more than five times as much oil as the next largest sector) and is also the fastest-growing sector. DOE has developed both a long-term and a transitional solution to address this problem.

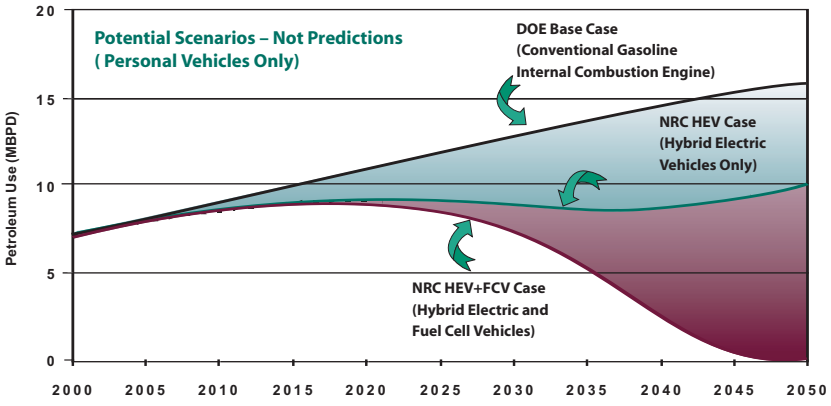
The solution: in the long term, develop hydrogen fuel cell vehicles; during the Transition, make today's vehicles more efficient and able to use alternative fuels

Partnering with industry, the U.S. Department of Energy (DOE) is leading the nation's long-term research effort to develop technologies for (1) the move from petroleum-fueled personal vehicles (cars, pickup trucks, sport utility vehicles [SUVs], and minivans) to those powered by fuel cells that run on hydrogen made from diverse domestic resources, and (2) double the fuel economy of new commercial vehicles (long-haul freight trucks and buses), which, for the foreseeable future, will continue using engines that run on improved liquid fuels, including those from renewable and nonconventional sources. Moving to hydrogen is widely seen as the most promising long-term means of eliminating the transportation sector's dependence on petroleum. The two DOE partnerships with industry are the FreedomCAR and Fuel Partnership and the 21st Century Truck Partnership.

DOE's FreedomCAR and Vehicle Technologies (FCVT) Program is implementing the Transition Strategy to:

- Dramatically reduce oil consumption by improving the efficiency of personal vehicles
- Double fuel economy in commercial vehicles
- Develop many of the core technologies needed for tomorrow's fuel cell hybrid vehicles

Potential oil savings scenarios from FCVT and the National Research Council (NRC)



In the near term, hybrid vehicles will significantly slow the increasing rate of oil use in personal vehicles. In the long term, hydrogen fuel cell vehicles could eliminate oil use in personal vehicles. Not Shown: By 2050, FCVT's work will also greatly reduce petroleum use in commercial vehicles.

Clean diesel engine improves SUV fuel economy by 50%

FCVT worked with Cummins Engine Company to develop a prototype 200- to 250-horsepower diesel engine suitable for personal trucks that enables towing, hauling, and 4-wheel-drive capabilities. Dynamometer tests on personal trucks and SUVs using the prototype diesel engine have shown it improves fuel economy by at least 50 percent, compared with a gasoline engine, while meeting U.S. Environmental Protection Agency (EPA) Tier 2, Bin 5 vehicle emissions standards.

Testing now underway indicates that the 120,000-mile lifetime operation of the emission control system under the EPA Tier 2, Bin 5 standards is achievable.

DOE's Transition Strategy: develop efficient, affordable technologies that reduce oil use in the near term and are integral to future fuel cell vehicles

Because it may take decades for fuel cell vehicles to make a substantial impact, it is important to find other ways to start reducing oil use sooner. DOE has a Transition Strategy to help improve our energy security until fuel cell vehicles can dominate the market. The Transition Strategy involves developing advanced personal and commercial vehicle technologies that will help dramatically reduce oil consumption as soon as possible (while also helping achieve the nation's long-term goal of driving fuel cell vehicles). These new technologies include components for hybrid electric vehicles (batteries, electric drivetrains, and controllers), lightweight materials, improved fuels, advanced combustion engines, and other improvements that make today's hybrids more efficient and that will serve as "core components" in tomorrow's fuel cell vehicles.

Implementing the Transition Strategy: DOE's FreedomCAR and Vehicle Technologies (FCVT) Program

The FCVT Program, which has a long history of successful partnerships with industry, implements DOE's Transition Strategy through the research and development (R&D) of more energy-efficient and environmentally friendly highway vehicle technologies that reduce petroleum use. FCVT's comprehensive, integrated efforts are overcoming the many technical barriers to producing much more efficient petroleum-fueled and alternative-fueled personal and commercial vehicles.

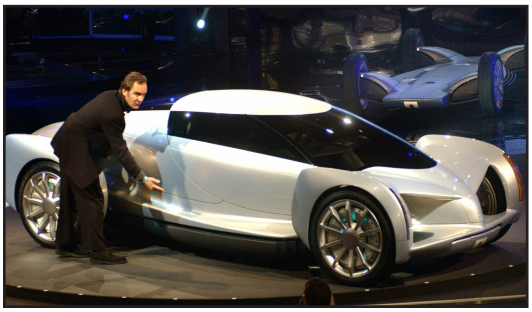
FCVT's technologies will improve our nation's energy and economic security

FCVT is the only DOE program that is developing technologies to improve the fuel economy of personal vehicles (during the Transition period) and commercial vehicles (in the mid- and long-term). These technologies will help maintain freedom of mobility, a wide range of vehicle choices, and reliable freight transport. They are projected to reduce oil consumption by up to 8 million barrels per day (mbpd) by 2040 (nearly equaling current U.S. oil imports), as shown in the chart above, and they are essential as a foundation for efficient fuel cell vehicles. Reducing oil consumption can have a beneficial impact on oil prices and help increase our nation's GDP, which in turn will expand the job market.

Two DOE programs are leading the R&D efforts

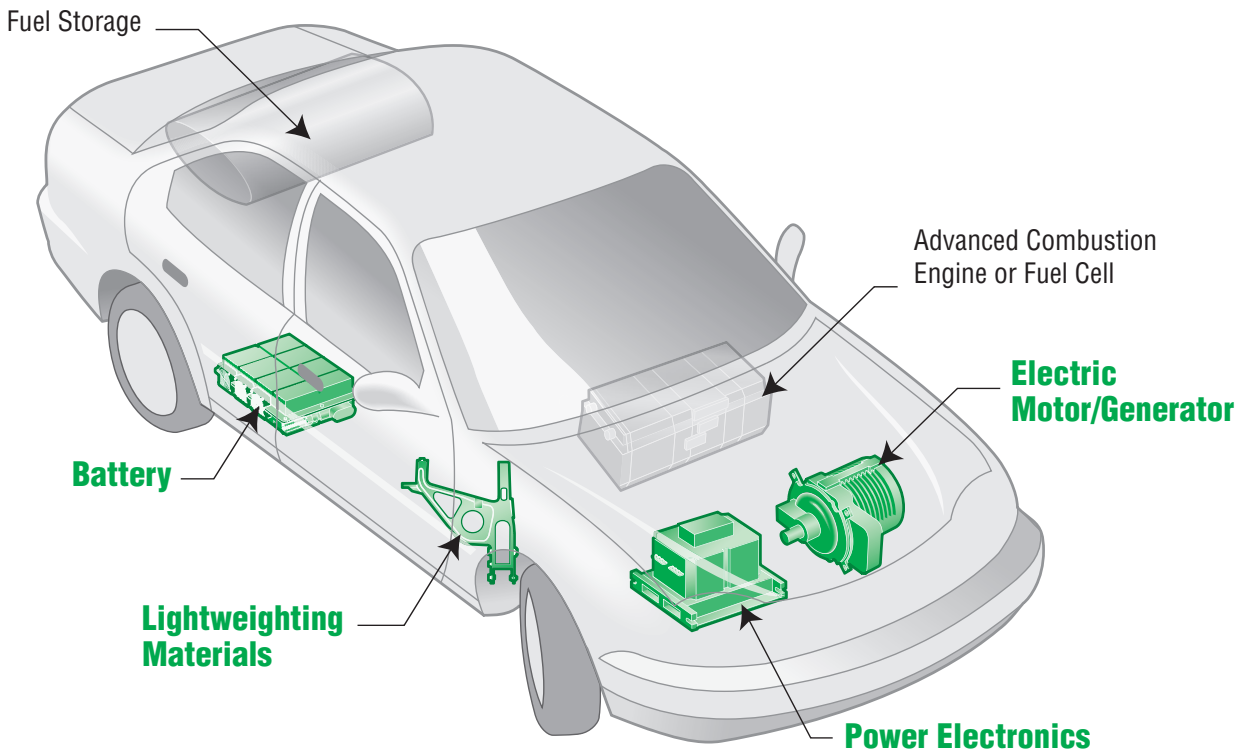
Expediting the introduction of FCVT's advanced vehicle technologies into personal and commercial vehicles will greatly enhance our energy security well before fuel cell vehicles are in widespread use. Considerable research and development is still required to make fuel cell vehicles practical. However, today's energy security concerns dictate that we start reducing oil imports through improved efficiency and fuel substitutions as quickly as possible.

The FreedomCAR and Vehicle Technologies (FCVT) Program leads DOE's partnerships with industry to develop advanced technologies for both personal and commercial vehicles. FCVT's sister program, the Hydrogen, Fuel Cells & Infrastructure Technologies Program, leads DOE's development of fuel cells, as well as hydrogen production, storage, and distribution infrastructure. These two DOE programs work together as part of a single continuum of technologies, leading toward a future in which the vehicles we drive will not be dependent on petroleum and will have zero or near-zero emissions.



Dr. Larry Burns, General Motors Vice President of Research and Development, introduces the AUTOnomy, a concept vehicle designed from the ground up around fuel cell propulsion. "We're looking to literally reinvent the automobile," said Burns. "In addition to fuel cells and hydrogen storage, the FreedomCAR program, on the vehicle side, is helping to develop key enabling technologies, including advanced motors, power electronics, and batteries, as well as innovative lightweight materials, such as low-cost carbon fiber."

FCVT's work will help make advanced hybrid and fuel cell vehicles practical and efficient



FCVT's technologies (shown in green) for today's advanced vehicles will also help enable tomorrow's hybrid fuel cell vehicles by optimizing the performance and lowering the costs of four of the six "core" technologies required.

Tomorrow's fuel cell vehicles will also be "hybrids"

What makes a vehicle a "hybrid?"
Using a large battery pack in addition to an internal combustion engine or fuel cell (as opposed to using a small battery just for starting the engine) is what typically makes a vehicle a "hybrid." In order to efficiently use the energy stored in the battery pack, a hybrid vehicle requires advanced electronics, controls, and an electric motor that can also be used as a generator.

In other words: storage battery + internal combustion engine (or fuel cell) + motor/generator + power management = hybrid vehicle.

Why is hybrid technology important?
Batteries are not only useful in helping power hybrid vehicles, they also make these vehicles more efficient by helping capture, store, and use "waste energy." For example, "regenerative braking" captures the vehicle's kinetic energy to produce electricity, instead of producing heat (wasted energy) as conventional vehicles do.

Hybrid technologies, such as batteries and the systems that manage electrical power, will also be required for tomorrow's fuel cell vehicles, because fuel cells produce electricity — not mechanical energy — that will need to be stored and managed. However, today's hybrid components still fall short of the cost and performance levels needed to achieve widespread consumer acceptance.

FCVT partners with industry to help keep its R&D focused and facilitate technology commercialization

FCVT works with many industry partners to help identify technology barriers and establish technical targets, which ensures an appropriate focus for research and development and also facilitates future commercialization. DOE's approach to working with the automotive and truck industries is *"collaboration, then competition,"* which means encouraging companies to work together on precompetitive research, then letting the resulting new and more efficient technologies compete in the marketplace.

FCVT technologies are already starting to make a difference

FCVT research and development is leading to a comprehensive suite of new technologies, including hybrid vehicle components, such as electric motors, energy storage units (e.g., batteries) and power electronics; advanced combustion systems and improved fuels; lightweighting materials; and sophisticated vehicle systems. Many of these innovative technologies are already in vehicles or soon will be (see sidebars on the following pages for summaries of some recent FCVT successes).

Hybrid Systems Research can reduce vehicle fuel use by 40 percent or more while also making these vehicles affordable

Hybrid vehicles are on our roads today because DOE initiated global research efforts on hybrid vehicle technologies in the late 1980s and 1990s. However, research and development is still necessary to make hybrids, including today's gas-electric and tomorrow's fuel cell vehicles, more efficient, more affordable, more durable, and manufacturable in high volume. The cost of a hybrid drive system is now estimated to be over $3,000 more than that of a conventional drive system. FCVT's work is expected to reduce the incremental cost of hybrid drivetrains to offer consumers a 3-year payback, which requires reducing the cost for energy storage to about $500 and that for advanced power electronics and electric motor/generators to under $700.

Energy Storage. Batteries for energy storage are critical for both types of advanced hybrid vehicles — those with internal combustion engines and those with fuel cells. Research goals include developing batteries that cost less, have higher energy densities, and last longer. Lithium-ion batteries are now the main focus because of their greater performance potential. Longer term, FCVT conducts basic exploratory research that involves developing more advanced battery cells, anodes, cathodes, electrolytes, diagnostics, and modeling. The goal is to reduce the cost of advanced hybrid vehicle battery systems from approximately $1,500 today to about $500 by 2010.

Advanced power electronics and electric motor/generators. These systems enable hybrid vehicles to operate on electrical energy and recover energy from braking. Research in this area focuses on (1) developing technologies that are highly reliable, extremely efficient, and very rugged and (2) reducing cost, weight, and size. For example, today an integrated power electronics and traction motor system weighs approximately 132 pounds (60 kg) and costs $1,200. FCVT's research objective is to reduce the weight to 100 pounds (46 kg) and the cost to under $700 for the same system by 2010. These systems must also be compatible with high-volume manufacturing methods.

Advanced Combustion Engine and Fuels Research is a rapid route to significant oil savings

FCVT research focuses on developing improved internal combustion engines that have the potential for high efficiency and near-zero exhaust emissions. These engines will be able to operate on gasoline-like or diesel-like fuels, as well as renewable fuels. Improving combustion engine efficiencies and using nonpetroleum-based fuels in both personal and commercial vehicles could reduce fuel consumption by more than 50 percent, compared to today's conventional vehicles.

FCVT's research seeks to better understand and improve the in-cylinder combustion processes of compression ignition (diesel-fueled) engines, reduce emissions formation, improve the effectiveness of exhaust aftertreatment technologies, and optimize fuel formulations. The primary objective is to dramatically improve combustion efficiencies and thereby increase the fuel economy of both personal and commercial vehicle engines.

More advanced fuels are essential for higher-efficiency engines. FCVT's fuels research seeks new petroleum-based and nonpetroleum-based fuel formulations that are cost competitive, increase fuel economy, reduce emissions, and help eliminate our dependence on oil imports. Nonpetroleum fuels, such as ethanol and biodiesel, also contribute to reducing oil consumption by directly displacing petroleum. FCVT's research target is to develop technologies that could displace 5 percent of the oil used for highway transportation. Research will address the barriers to using more nonpetroleum fuels, which include their higher cost, different physical and chemical properties (sometimes creating storage and handling complexities), and their lesser-known combustion and emissions characteristics. It will also be essential to determine what fuel characteristics contribute to better combustion and how much variability in fuel mixtures will be acceptable.

"In our lifetime, we will have to deal with a peak in the supply of cheap oil. That peak will be a watershed moment."

— Robert Kaufmann, Economist
Boston University

FCVT fuels research helps EPA set sulfur levels for diesel fuel

EPA standards for commercial vehicle diesel emissions will soon require over a 90% reduction in nitrogen oxide and particulate matter. FCVT researchers recognized early on that new emission control devices would be adversely affected by the sulfur typically found in diesel fuel, so they collaborated with EPA and industry stakeholders to quantify the effects of fuel sulfur on emission control technologies.

Results showed that a fuel sulfur level below 15 ppm would be required. In its 2007 commercial vehicle diesel engine emissions standards, EPA included a mandate to phase in 15-ppm sulfur diesel fuel starting in 2006. FCVT has since expanded its efforts to evaluate fuels and lubricants for efficient, durable, low-emission vehicles. The results of this work are being used to support EPA's rule-making efforts and provide technical data to help industry meet future EPA requirements.

U.S. automakers partnered with DOE to develop essential hybrid technologies

In the mid-1990s, DOE's advanced vehicle technologies program partnered with USCAR, an alliance of U.S. automakers, in precompetitive research to jointly develop essential, "core" hybrid vehicle technologies.

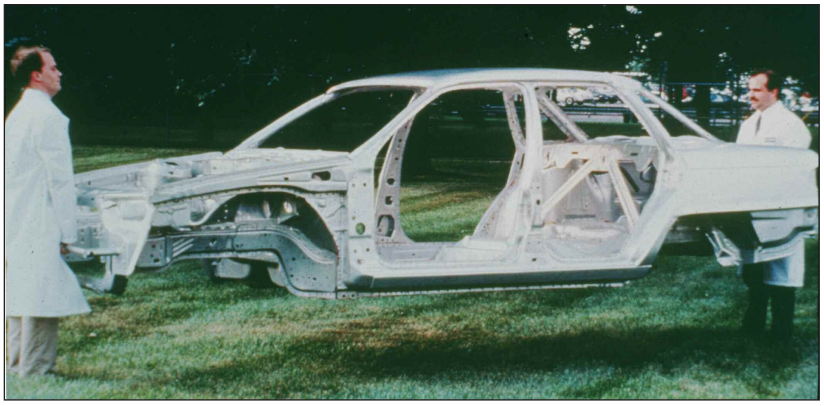
To date, this research has helped foster the development of the Ford Escape Hybrid SUV and the General Motors Silverado/Sierra Full-Size Hybrid Pickup Truck — both of which are now available to consumers. These vehicles target the personal truck market, where sales are highest and the need for improved fuel economy is greatest. These and other DOE industry partners were able to apply, and expand on, the results from DOE-sponsored, precompetitive hybrid research as they developed their proprietary technologies and products to meet the specific needs of their customers.

"Our partnership with DOE to perform precompetitive research enhanced our capability to develop the Ford Escape Hybrid, the world's first full-hybrid SUV, to meet the performance needs of our SUV customers while delivering significantly better fuel efficiency and ultra-low emissions."

Tom Watson, Manager
Hybrid Electric Vehicle Powertrains
Ford Motor Company

***Materials Technologies Research** makes vehicles lighter, improving their fuel economy, while retaining their durability and safety*

FCVT's technical targets include making high-strength lightweight materials more affordable while also meeting vehicle performance, safety, and recyclability objectives. For personal vehicles, reducing the weight by half by using lighter, lower-cost structural materials could result in fuel economy increases of 30 percent. (As a rule of thumb, for personal vehicles, every 10 percent reduction in weight can result in about a 6 percent increase in fuel economy.) Similar lightweighting materials will be used in different configurations to reduce the weight of commercial vehicles. Materials research by FCVT is also helping improve engine efficiency, reduce component costs for electric motors and power electronics, and reduce parasitic energy losses in commercial vehicles.



This prototype vehicle frame demonstrates how aluminum and other advanced materials can reduce vehicle weight to help improve fuel economy.

***Vehicle Systems Research** improves the efficiency of components and ensures that they work in vehicles*

Research into vehicle systems focuses on the component and subsystem levels through development, modeling, and testing. The results guide overall research, allowing FCVT to focus on the most appropriate areas; they are also used to validate that the resulting components and systems will work in a vehicle environment.

FCVT is working to improve system efficiencies and optimize energy management. For personal vehicles, these technologies are critical to reducing the added cost of hybrid systems, which would facilitate wider consumer acceptance.

For commercial trucks, systems research is developing technologies that will recover heat energy that is currently unused and reduce other parasitic energy losses, such as those

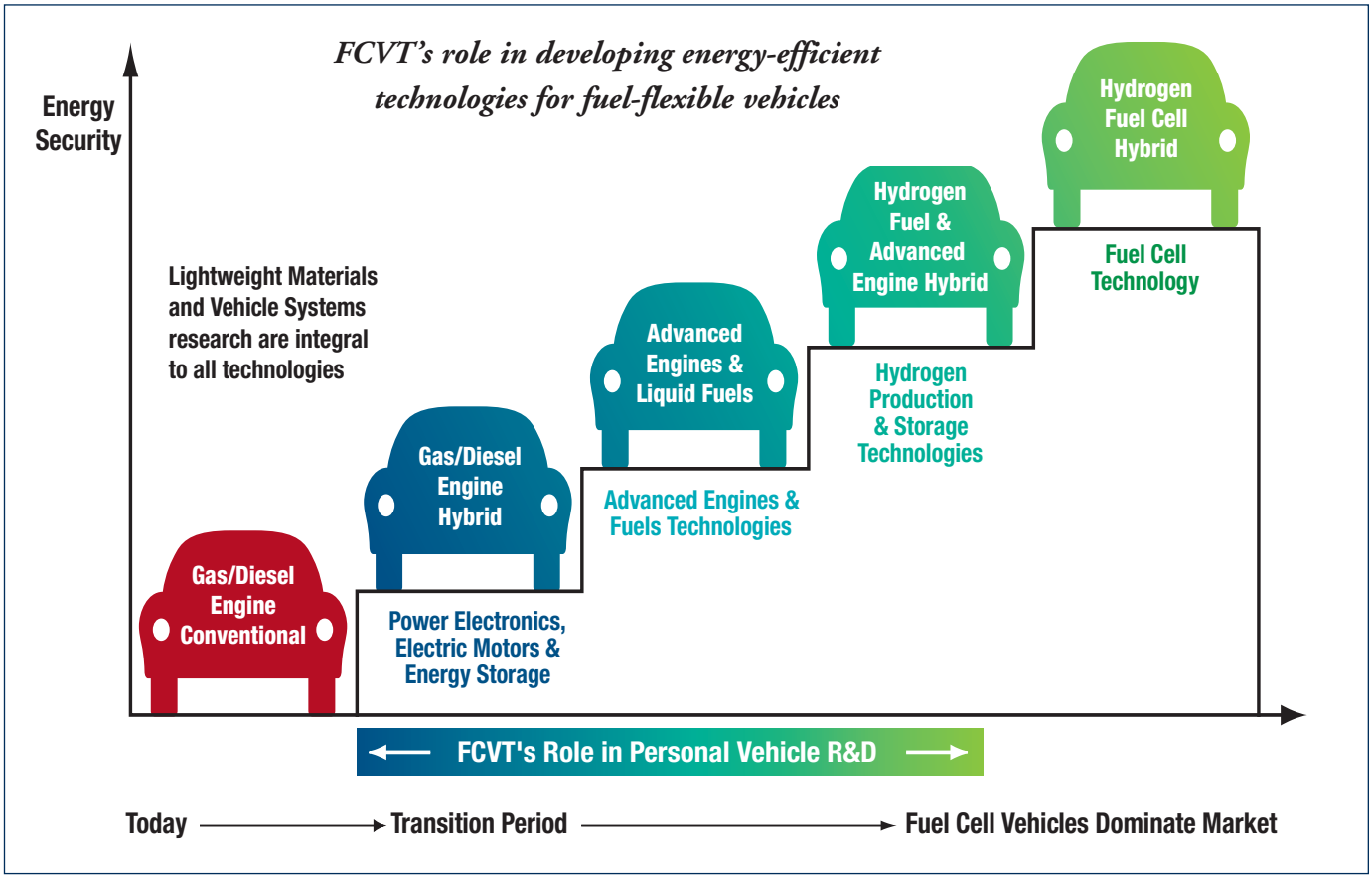
caused by aerodynamic drag and by operating auxiliary systems. Reducing the cost of improvements so that commercial truck buyers will see a payback from fuel savings within two years is a key research driver.

FCVT's R&D is improving personal vehicles

Personal vehicles (passenger cars and personal trucks) now account for 75 percent of the oil consumed for highway transportation. FCVT seeks to develop more energy-efficient and environmentally friendly highway transportation technologies (for both cars and trucks) that will enable our nation to use significantly less petroleum. To help achieve this goal, FCVT collaborates with General Motors, Ford, and DaimlerChrysler (via USCAR, the U.S. Council for Automotive Research) and with energy companies through the FreedomCAR and Fuel Partnership. DOE's research in support of Partnership goals has already resulted in significant technological advances, such as those leading toward advanced internal combustion engines

"People should be doing something now to reduce oil dependence and not waiting for mother nature to slap them in the face."

— Alfred Cavallo, Energy Consultant Princeton, New Jersey



The U.S Department of Energy's FreedomCAR and Vehicle Technologies (FCVT) Program is playing an enabling role in developing advanced technologies during the transition to fuel cell vehicles.

This FCVT prototype "More Electric" truck features electrically powered accessories.

"More Electric" truck reduces fuel consumption by at least 8%

FCVT partnered with Caterpillar, Engineered Machined Products, Emerson, and Kenworth to develop an "electrified" commercial truck. Instead of having mechanically powered, belt-driven accessories (such as water pumps, alternators, and compressors), the new truck would have electrical accessories powered by an electrical generator that is integrated into the engine.

DOE's prototype "More Electric" truck features: (a) an electrically powered cab heating, ventilating, and air-conditioning module; (b) a high-efficiency 30-kW starter/generator; (c) an integrated auxiliary power unit; and (d) a "shore power" connection (to permit plugging in at truck stops to warm the engine and operate cab auxiliaries). Test results showed an 8% overall reduction in fuel consumption — 2% during highway driving and almost 6% by not idling the main engine overnight.

(including homogeneous-charge compression-ignition engines and those fueled by hydrogen), improved emissions controls for diesel engines, stronger and lighter materials, alternative fuels, and high-power lithium-ion batteries with longer life cycles for hybrid electric vehicle systems.

FCVT's R&D is also improving commercial vehicles

Commercial long-haul vehicles are expected to remain dependent on internal combustion engines and the petroleum-based liquid fuels they burn for the foreseeable future, because of their performance, range, and power requirements. Fuel cells could enter this market as auxiliary power units to save fuel and reduce emissions from engine idling. Commercial vehicles are predominantly powered by diesel engines, which are significantly more efficient than gasoline-fueled engines. However, there remains room for considerable efficiency improvements in diesel engines.

In the 21st Century Truck Partnership, FCVT is teaming with three other federal agencies and 15 industry partners representing commercial vehicle and component manufacturers, truck and bus manufacturers, and hybrid vehicle powertrain suppliers. Involving key industry participants greatly improves commercial opportunities for FCVT-supported technologies. Key areas where improvements are having maximum impact include (1) improved engine efficiency and reduced emissions (including fuels technology, aftertreatment, and propulsion systems), (2) cost-effective advanced commercial hybrid propulsion systems, (3) minimized parasitic losses (such as those resulting from aerodynamic drag, engine idling, friction and wear, and rolling resistance), and (4) stronger and lighter materials.

DOE's Transition Strategy provides achievable, incremental advances toward the long-term goal

DOE takes an integrated, comprehensive approach to vehicle research and development. The objective is to develop Transition technologies that are practical and achievable and that incrementally improve upon today's conventional vehicles. In turn, these new technologies also facilitate the long-term move to hydrogen fuel cell vehicles. This approach reduces risk by implementing fuel-saving technologies as soon as possible while research continues on longer-term technologies.

The importance of this risk-reducing, incremental approach cannot be overstated, given the challenges inherent in the long-term development of hydrogen-based transportation

technologies and their supporting infrastructure. As oil reserves diminish and fuel prices remain high, DOE's strategy is the best technology approach to reducing oil consumption over the next 20 years while meeting the technical and economic challenges of developing hydrogen fuel cell vehicles.

Successful research and development may not be enough for new technologies to gain acceptance in the marketplace

Research and development of new energy-efficient technologies is critical during the Transition to a more secure energy future, but R&D alone might not be sufficient. Overcoming commercialization barriers will be necessary to speed the introduction of advanced technologies in the marketplace and help ensure market acceptance of clean vehicle technologies that reduce petroleum use. New technologies can take up to 15 years to achieve full market penetration. Consequently, consumer education, outreach, and/or incentives may be needed to create niche markets for early introduction and to prime the pump for mass market acceptance.

Also, markets may not recognize (or may not highly value) the benefits to society of certain public goods, like clean air, a stable global climate, and energy security. These benefits can be incorporated into individual market decisions through a variety of manufacturer and consumer incentives. Education and outreach activities that promote these public goods may be critical to accelerating market success of clean vehicle technologies that reduce oil dependence during the Transition.

Improving vehicle system efficiencies can have big benefits

Energy Security. Of the oil we consume, the amount imported from foreign countries is nearly 60 percent — and growing rapidly. Improving the efficiency of personal and commercial vehicles will have a dramatic and positive impact on energy security.

Emissions Reduction. Advanced combustion and hybrid electric vehicle technologies can significantly reduce regulated emissions and help reduce the impact of highway vehicles on the environment. FCVT-supported technologies can reduce greenhouse gases, particulates, and oxides of nitrogen so that tomorrow's vehicles will have near-zero regulated emissions.

FCVT Successes

DOE partnerships with industry have produced many research and development successes necessary to help achieve the oil savings outlined by the Transition Strategy. For example:

- All commercially available hybrid electric vehicles now produced by Toyota, Honda, and Ford are using nickel metal hydride batteries. This technology was developed by the United States Advanced Battery Consortium with DOE funding.
- FCVT researchers developed and commercialized a carbon fiber-reinforced composite component that is 60% lighter than the steel part it replaces.
- In a one-year, on-road evaluation, DOE demonstrated more than a 90% reduction in particulate matter from commercial trucks and buses when operated with diesel particulate filters and ultra-low-sulfur fuel. This work is key for continued use of fuel-efficient diesel engines.
- In 2004, a new oil filtration system was marketed that reduces by half the number of oil changes per year for up to 80% of commercial trucks. The system has the potential to reduce the use of petroleum-based products by 30 million gallons per year.

Some FCVT Award-Winning Technologies and Processes

R&D *Magazine Top 100 Technologies (R&D 100) Awards:*

2004 Powertrain System Analysis Toolkit Software
2003 CF8C-Plus High-Temp Stainless Steel
2002 Spiral Notch Torsion Test
2001 Hydrocarbons-to-Hydrogen Catalyst
2001 Charging Algorithm to Extend Lead-Acid Battery Life
2001 Catalyst Material for a Plasma-Catalyst Device
2000 High-Thermal-Conductivity, Low-Density Graphite Foam
1999 Compact Microchannel Fuel Vaporizer
1999 Clean Diesel Technology
1998 Near-Frictionless Carbon Coating
1997 Chemicals from Biologically Derived Succinic Acid
1997 Metal Compression Forming
1996 Variable-Conductance Insulation Catalytic Converter
1996 Thin-Film Rechargeable Batteries
1995 Single Fermenter Cellulosic Biocatalyst
1995 Gelcasting
1993 Ethanol from Corn Fiber

Also: six FLC Awards for Excellence in Technology Transfer, three *Discover* Magazine awards, and many others

Economic Benefits. Estimates of the impact of all oil price increases, due largely to OPEC actions, since the 1970s are in the trillions of dollars. Thus, the potential economic benefits of DOE's Transition Strategy are significant. The cumulative savings in oil over the next 25 years could be almost 20 billion barrels. That's almost $1 trillion at 2004 prices of $50 per barrel. The savings would make a substantial contribution to bettering our nation's economy. In addition, the United States is the world leader in commercial vehicle research and development and, more than other nations, relies on commercial vehicles for moving freight. As the rest of the world improves its infrastructure and increases commercial vehicle use, maintaining our leadership in commercial vehicle research and development, while remaining competitive in developing new personal vehicle technologies, will provide future exports, protect U.S. jobs, and help lower the trade deficit. Reducing oil consumption also helps reduce indirect costs, including the "hidden" costs of addressing air pollution and improving public health.

DOE's Transition Strategy is leading our nation to a secure energy future

DOE and FCVT have the world-class knowledge, expertise, and resources needed to accomplish the nation's long-term and Transition Strategy energy goals. FCVT already has extensive, comprehensive research and development activities in place that are producing award-winning results and attracting the cooperation of industry.

DOE's Transition Strategy and its resulting technologies will be invaluable no matter when fuel cell vehicles are commercialized. In the next few years, as FCVT technologies appear in more U.S. vehicles, our nation will begin the Transition toward a more secure energy future that offers economic and environmental benefits for generations of Americans.

The world will grow increasingly dependent on Middle East oil. Non-OPEC oil production is expected to peak in the next ten years.

— Rex Tillerson, President
ExxonMobil
December 2004

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

More detailed information on the FCVT R&D plan is provided in the document *FreedomCAR and Vehicle Technologies Program — Multi-Year Program Plan, Planned Program Activities for 2004-2008,* U.S. Department of Energy.
www.eere.energy.gov/vehiclesandfuels/resources/fcvt_mypp.shtml

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